

AA1599**CLAIMS:**

- 5 1. A process for treating exhaust gas from a compression ignition engine, wherein substantially all fuel for combustion is injected into a combustion chamber prior to the start of combustion, which process comprising contacting the exhaust gas with a catalyst comprising a supported palladium (Pd) catalyst and at least one base metal promoter.
- 10 2. A process according to claim 1, wherein the exhaust gas comprises >2000ppm carbon monoxide (CO).
- 15 3. A process according to claim 1 or 2, wherein the exhaust gas comprises >500ppm C₁ unburned hydrocarbons (HCs).
4. A process according to claim 1, 2 or 3, wherein the exhaust gas temperature is below 250°C.
- 20 5. A process according to any of claims 1 to 4, wherein the catalyst comprises platinum (Pt).
6. A process according to claim 7, wherein the catalyst is arranged so that the exhaust gas contacts the Pd and then contacts the Pt.
- 25 7. A process according to claim 5 or 6, wherein combustion of CO in the exhaust gas over the Pd creates an exotherm to heat the Pt, thereby promoting reactions of the exhaust gas components catalysed by the Pt.
- 30 8. A process according to claim 7, wherein reactions catalysed by Pt include HC oxidation and combustion of particulate matter.
9. A compression ignition engine wherein substantially all fuel for combustion is injected into a combustion chamber prior to the start of combustion, which engine

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comprising an exhaust system comprising a supported palladium (Pd) catalyst and at least one base metal promoter.

- 5 10. An engine according to claim 9 producing exhaust gas comprising >2000ppm carbon monoxide (CO).
11. An engine according to claim 9 or 10, producing exhaust gas comprising >500ppm C₁ unburned hydrocarbons (HC).
- 10 12. An engine according to claim 9, 10 or 11, producing exhaust gas of below 250°C in temperature.
13. An engine according to any of claims 9 to 13, wherein the at least one base metal promoter is a reducible oxide or a basic metal or any mixture of any two or more
15 thereof.
14. An engine according to claim 13, wherein the at least one reducible oxide is an oxide of manganese, iron, cobalt, copper, tin or cerium.
- 20 15. An engine according to claim 14, wherein the at least one reducible oxide is at least one of MnO₂, Mn₂O₃, Fe₂O₃, CuO, CoO, SnO₂ and CeO₂.
16. An engine according to claim 13, 14 or 15, wherein the reducible oxide is dispersed on the support.
- 25 17. An engine according to claim 13, 14 or 15, wherein the support *per se* comprises particulate bulk reducible oxide.
18. An engine according to claim 13, wherein the at least one basic metal is an alkali
30 metal, an alkaline earth metal or a lanthanide metal or any mixture, compound oxide or mixed oxide of any two or more thereof.
19. An engine according to claim 18, wherein the at least one alkaline earth metal is barium, magnesium, calcium, strontium.
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20. An engine according to claim 18, wherein the at least one alkali metal is sodium, potassium or caesium.
- 5 21. An engine according to claim 18, wherein the at least one lanthanide metal is cerium or lanthanum.
22. An engine according to any of claims 9 to 21, wherein the catalyst comprises platinum (Pt), optionally supported Pt.
- 10 23. An engine according to claim 22, wherein the Pd and Pt are on the same support.
24. An engine according to claim 22, wherein the supported Pd and the at least one base metal promoter are disposed on a first substrate and the Pt is disposed on a second substrate, which second substrate is disposed downstream of the first substrate.
- 15 25. An engine according to claim 22, wherein the supported Pd and the at least one base metal promoter are disposed on an upstream part of a substrate and the Pt is disposed on a downstream part thereof.
- 20 26. An engine according to claim 22, wherein the Pt is disposed in a first layer on a substrate and the supported Pd and the at least one base metal promoter are disposed in a second layer overlying the first layer.
- 25 27. An engine according to claim 22, wherein a first support comprises of the supported Pd and the at least one base metal promoter and the Pt is carried on a second particulate support, wherein the first and second supports are disposed on a substrate in a single layer.
- 30 28. An engine according to any of claims 9 to 27, wherein the Pd support and, where present, the Pt support comprises at least one of alumina, silica-alumina, ceria, magnesia, titania, zirconia, a zeolite or a mixture, composite oxide or mixed oxide of any two or more thereof.

29. An engine according to claim 28, wherein the support comprises at least one basic metal.
30. An engine according to claim 29, wherein the at least one basic metal comprises at least one of zirconium, cerium, lanthanum, alumina, yttrium, praseodymium, barium and neodymium.
31. An engine according to any of claims 28, 29 or 30, wherein the support comprises lanthanum-stabilised alumina.
32. An engine according to claim 28, 29 or 30, wherein the support comprises ceria and zirconia, optionally in a weight ratio of from 5:95 to 95:5.
33. An engine according to any of claims 9 to 32, wherein the catalyst contains from 0.1 to 30%, optionally from 0.5-15% and preferably 1-5% by weight of PGM based on the total weight of the catalyst.
34. An engine according to claim 33, wherein the catalyst contains a weight ratio of from 100:0 to 10:90 Pd:Pt.
35. An engine according to claim 33 or 34, wherein the catalyst contains from 0.1 to 10% Pt by weight based on the total weight of the catalyst and from 0.1 to 20% by weight based on the total weight of the catalyst.
36. An engine according to any of claims 9 to 35, having a first running condition wherein the engine is configured to run during at least one portion of an engine cycle in a mode wherein substantially all fuel for combustion is injected into a combustion chamber prior to the start of combustion, and a second condition wherein the engine is configured to run in a conventional direct injection diesel engine mode.
37. An engine according to claim 36, wherein the engine switches to the second condition during high engine load.

38. An engine according to any of claims 9 to 37, comprising control means, in use, for controlling a fuel combustion mode of the engine.

39. An engine according to claim 38, wherein the control means comprises a pre-programmed processor and optionally forms part of the engine control unit (ECU).

40. An engine according to claim 39, wherein the exhaust system comprises an optionally catalysed particulate filter disposed downstream of the supported Pd catalyst.

41. An engine according to claim 39 or 40, including an exhaust gas recirculation valve and circuit to recirculate a selected portion of the exhaust gas to the engine air intake.

42. An engine according to claim 41, wherein the recirculated exhaust gas is cooled prior to mixing with the engine intake air.

43. A diesel engine according to any of claims 9 to 42.

44. A diesel engine according to claim 43, wherein it is a homogeneous charge compression ignition (HCCI) diesel engine or a Dilution Controlled Combustion System (DCCS) diesel engine.

45. A vehicle including an engine according to any of claims 9 to 44.

46. A light duty diesel vehicle according to claim 45.